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(54) Abstract Title
Vehicle safety braking system

(57) A safety braking system for improving safety during low speed manoeuvring or reversing of large vehicles includes means for sensing contact between a vehicle and another object and generating a contact signal, and means responsive to the contact signal to apply or release brakes on the vehicle. A bumper mounted pneumatic or electric sensor 201 on sensing a contact, when the speed of the vehicle is below a predetermined value, activates a solenoid valve 305 and shuttle valve 307 to supply air to operate the brakes. The brakes are released by means of manually operated valve 308. In other embodiments, the activated system supplies hydraulic fluid to the rear wheel brakes (503, Fig.5), the system is dependent on reverse gear being engaged rather than on the vehicle speed (Figs.6, 11 and 12), and a trailer based system (Fig.13) includes a back-up battery (BBU), a rubber bumper electric switch (201) and an ultrasonic proximity sensor (S). In a further embodiment, the sensing means is associated with the vehicle door to sense the presence of an obstruction e.g.a passenger, or an open door.

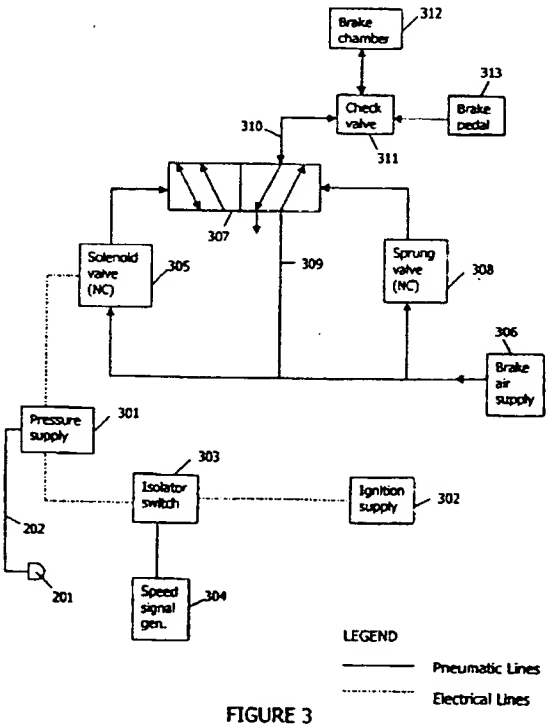

FIGURE 3

GB 2 340 902 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

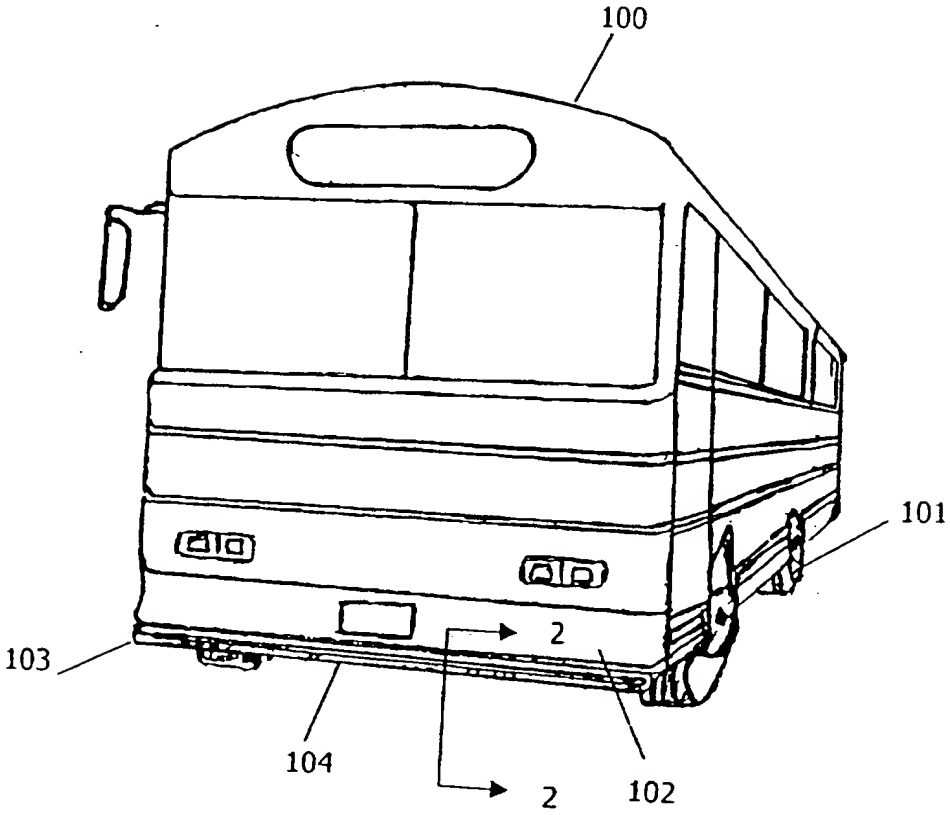

FIGURE 1

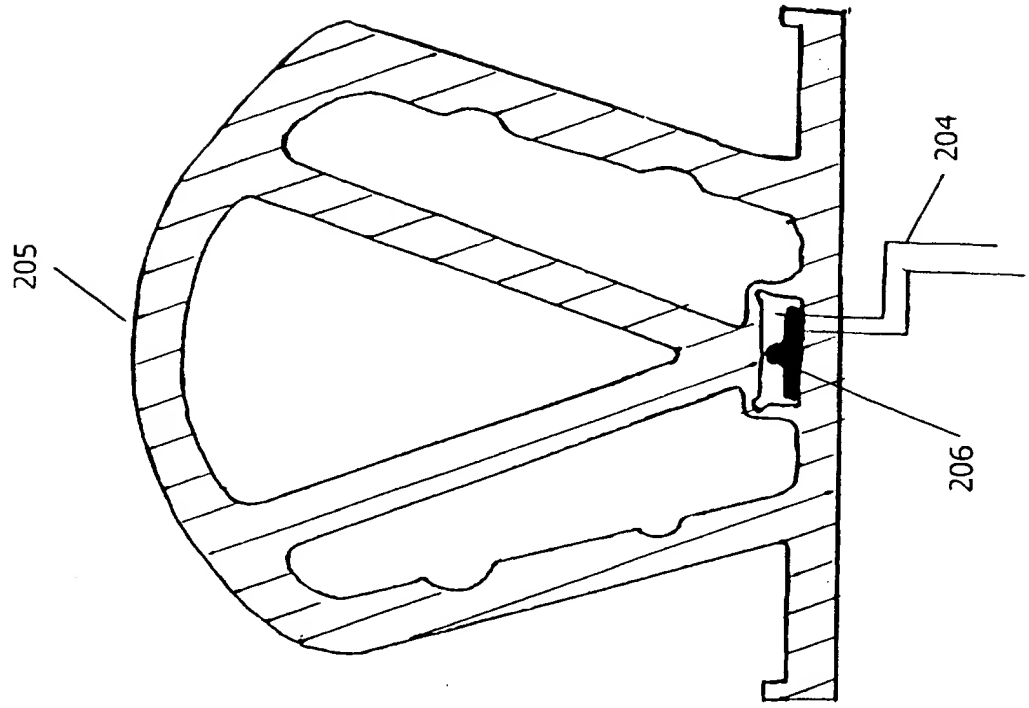

FIGURE 2B

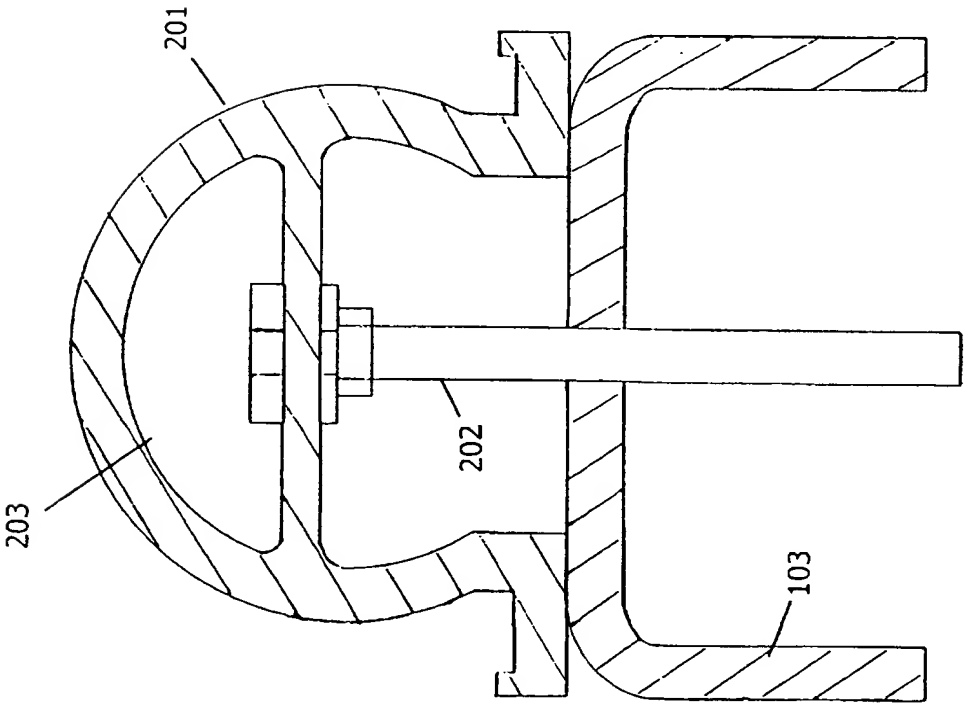

FIGURE 2A

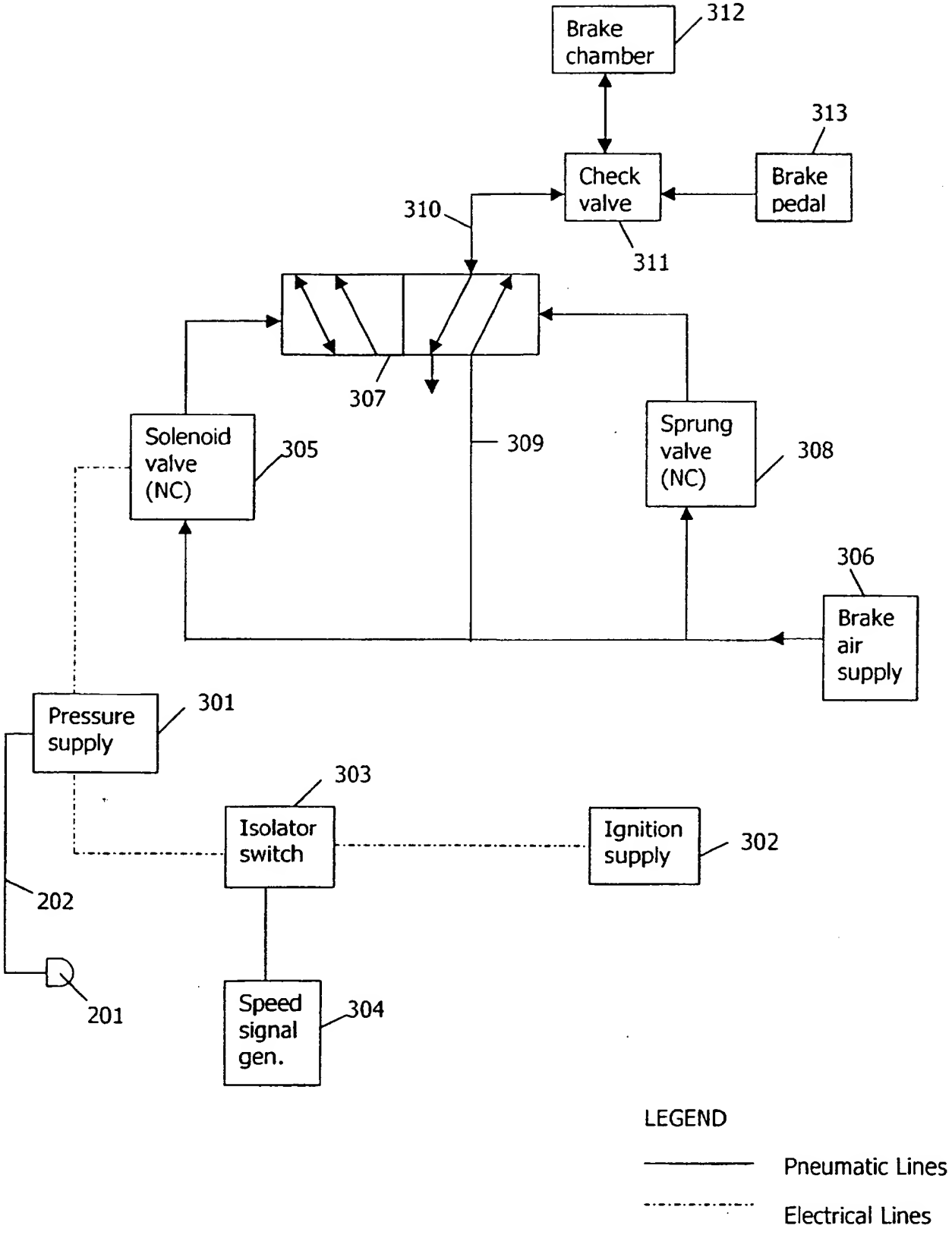
Brake chamber
312
313
Check valve
Brake pedal
310
311
307
Solenoid valve (NC)
305
309
Sprung valve (NC)
308
306
Brake air supply
Pressure supply
301
303
Isolator switch
Ignition supply
302
202
201
Speed signal gen.
304
LEGEND
Pneumatic Lines
Electrical Lines

FIGURE 3

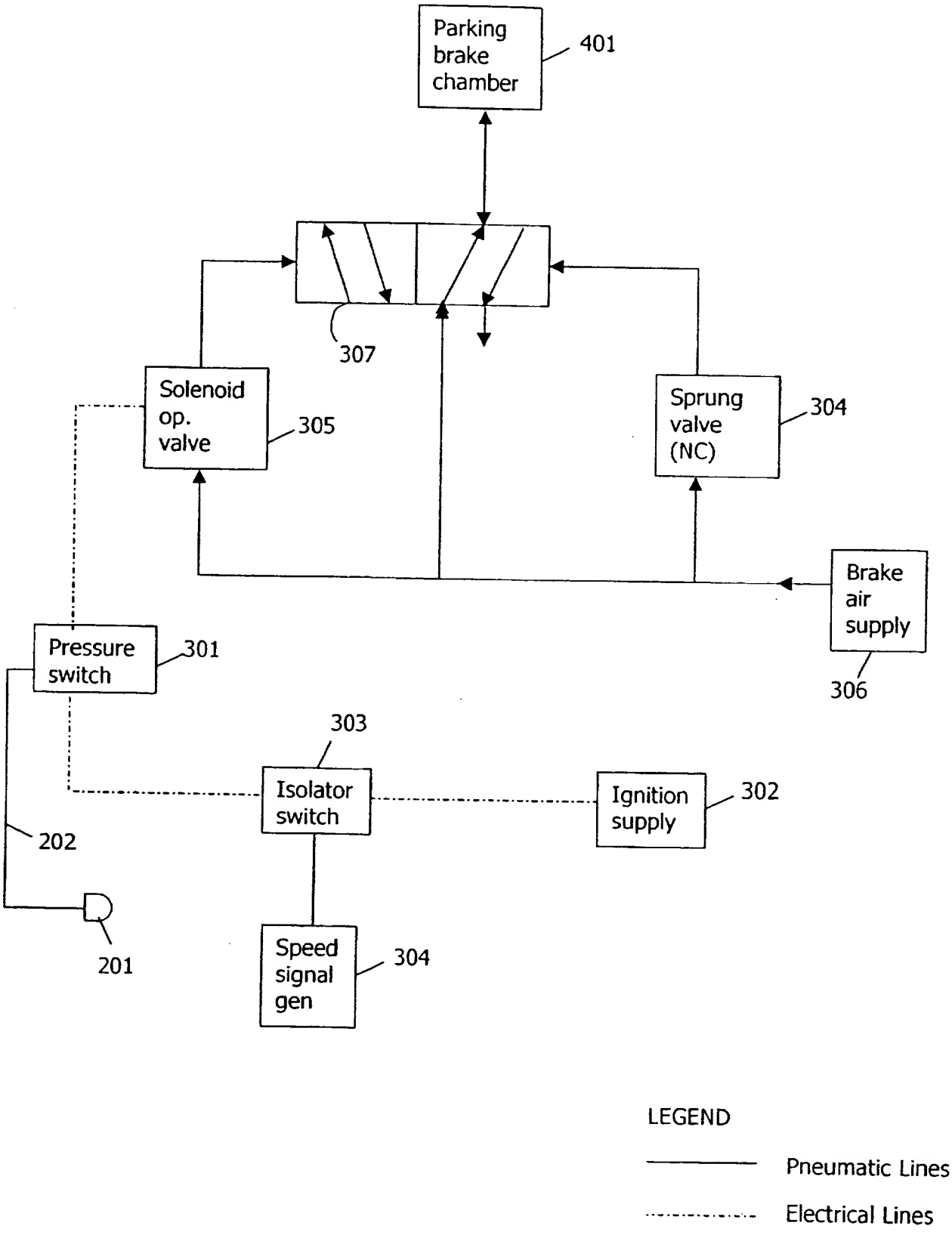
Parking brake chamber
401
307
Solenoid op. valve
305
Sprung valve (NC)
304
Brake air supply
306
Pressure switch
301
303
Isolator switch
Ignition supply
302
202
201
Speed signal gen
304
LEGEND
Pneumatic Lines
Electrical Lines

FIGURE 4

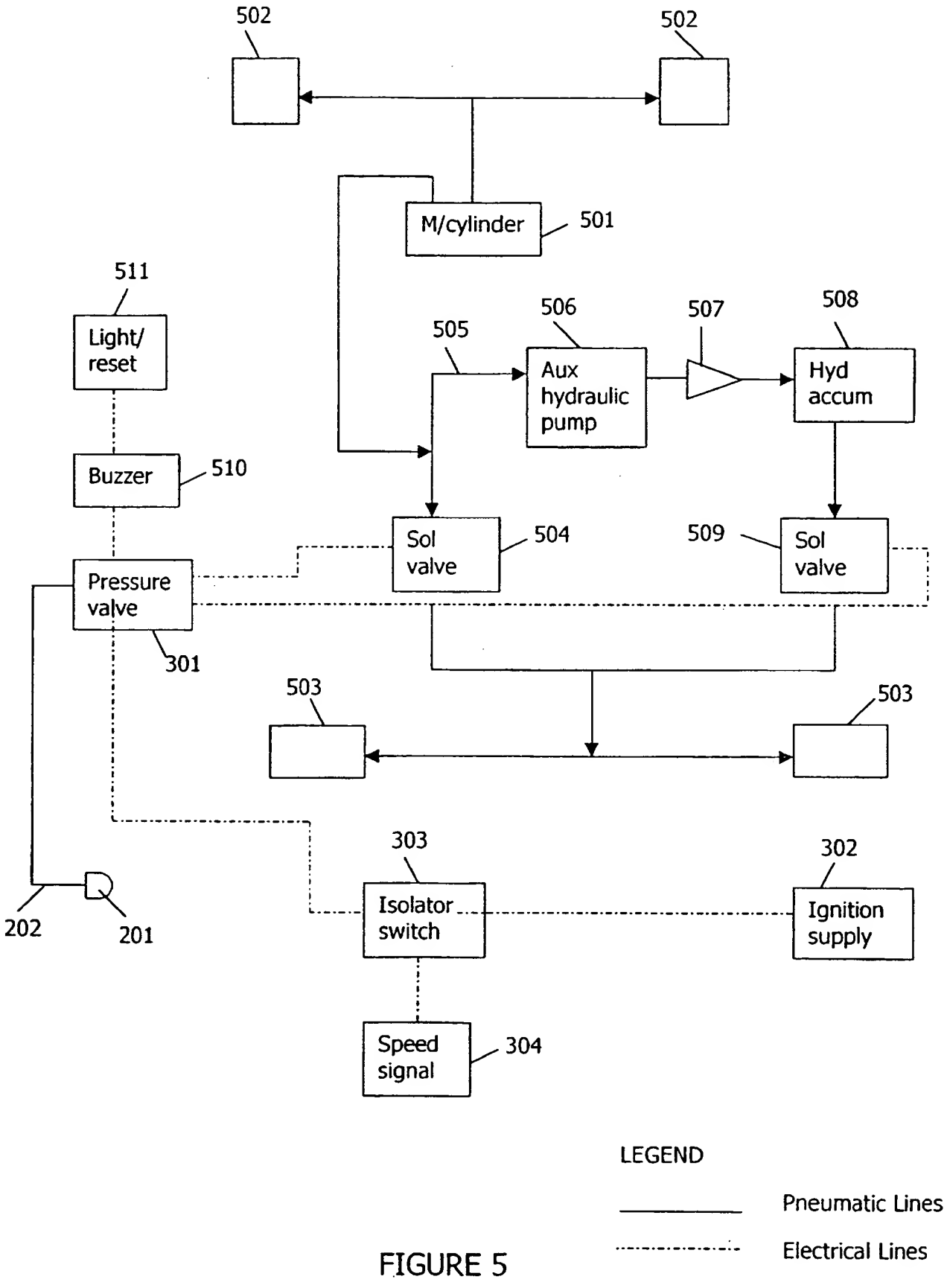
502
502
M/cylinder
501
511
Light/
reset
505
506
Aux
hydraulic
pump
507
508
Hyd
accum
Buzzer
510
Sol
valve
504
509
Sol
valve
Pressure
valve
301
503
503
303
302
Isolator
switch
Ignition
supply
202
201
Speed
signal
304
LEGEND
Pneumatic Lines
Electrical Lines

FIGURE 5

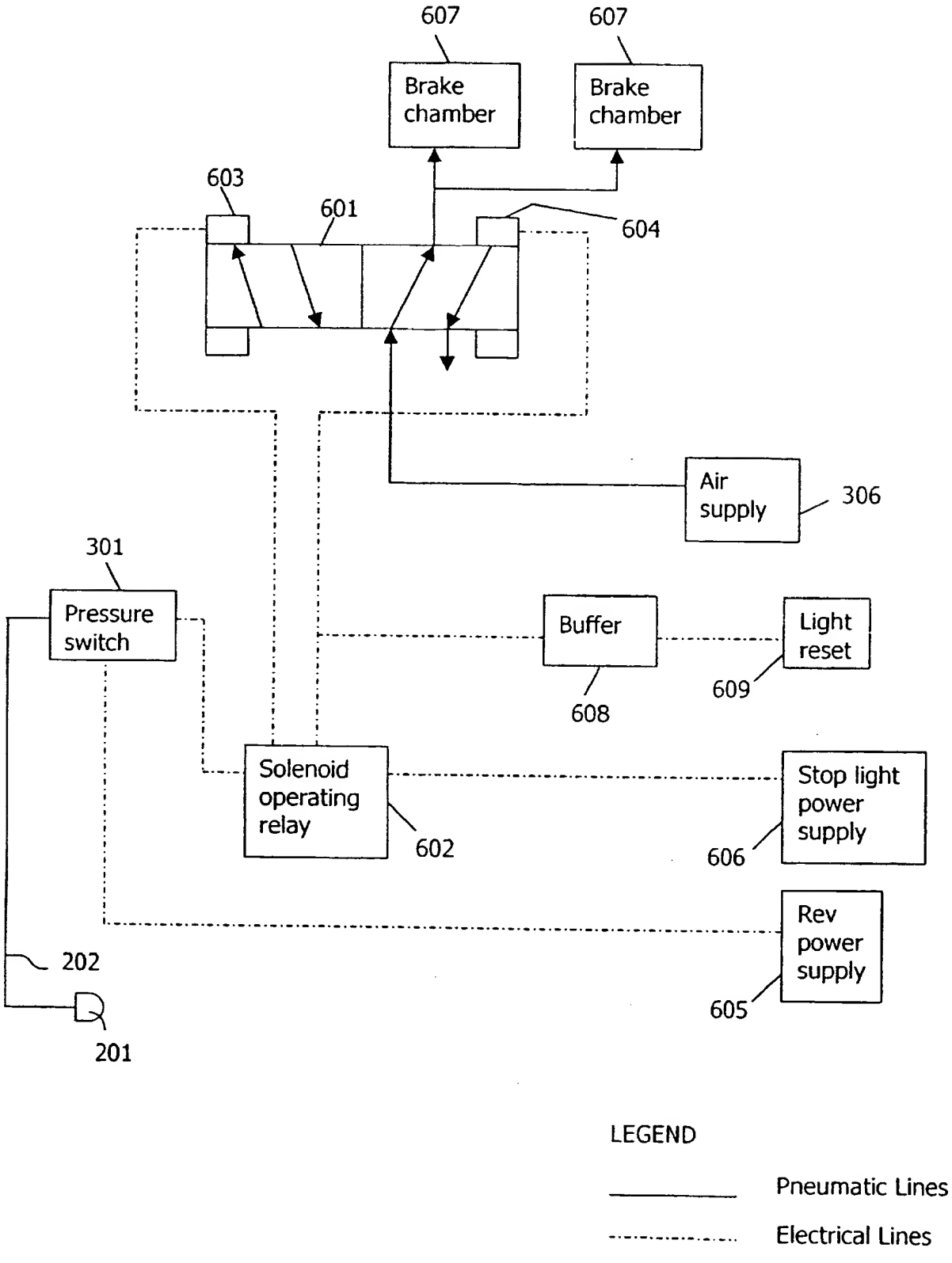
607
607
Brake chamber
Brake chamber
603
601
604
Air supply
306
301
Pressure switch
Buffer
Light reset
609
608
Solenoid operating relay
602
Stop light power supply
606
Rev power supply
605
202
201
LEGEND
Pneumatic Lines
Electrical Lines

FIGURE 6

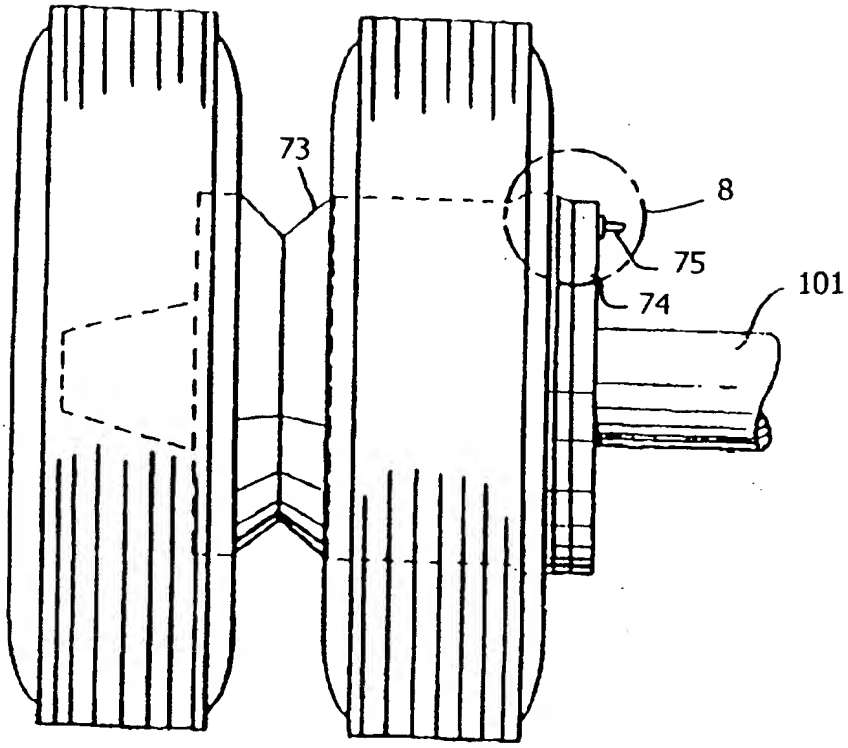

FIGURE 7

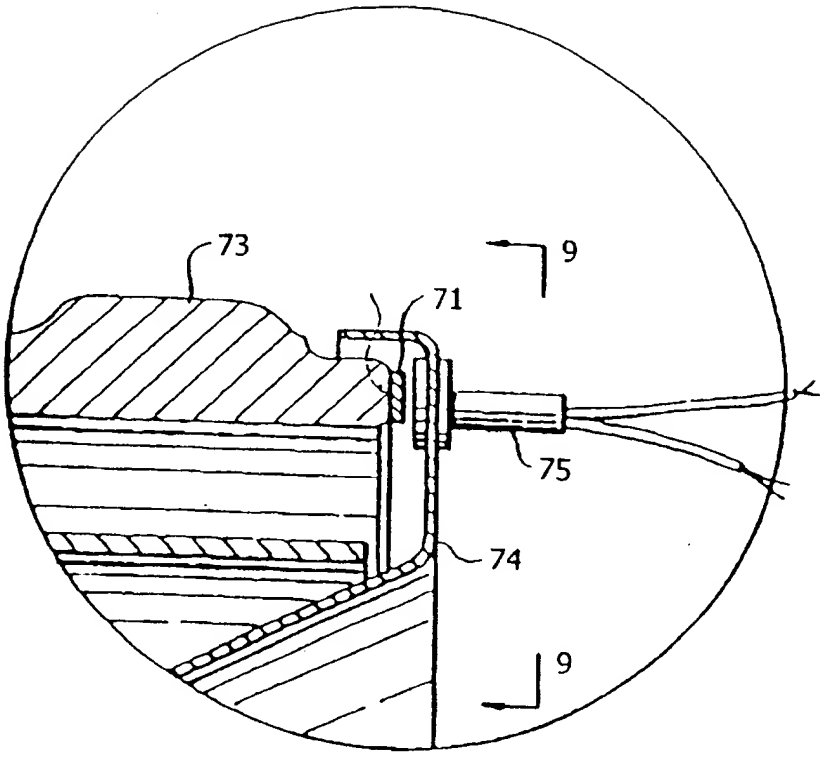

FIGURE 8

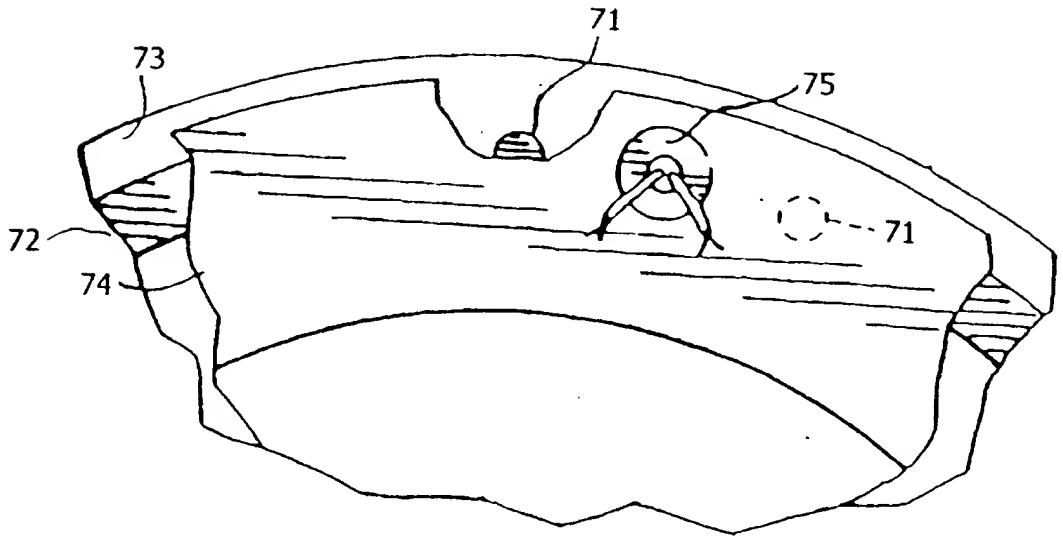

FIGURE 9

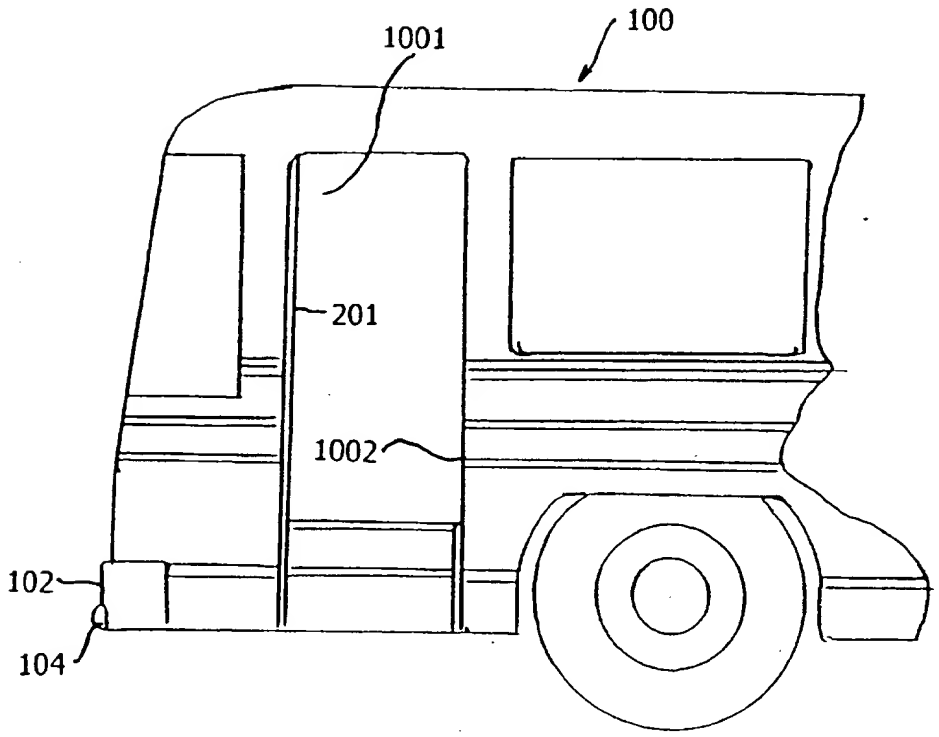

FIGURE 10

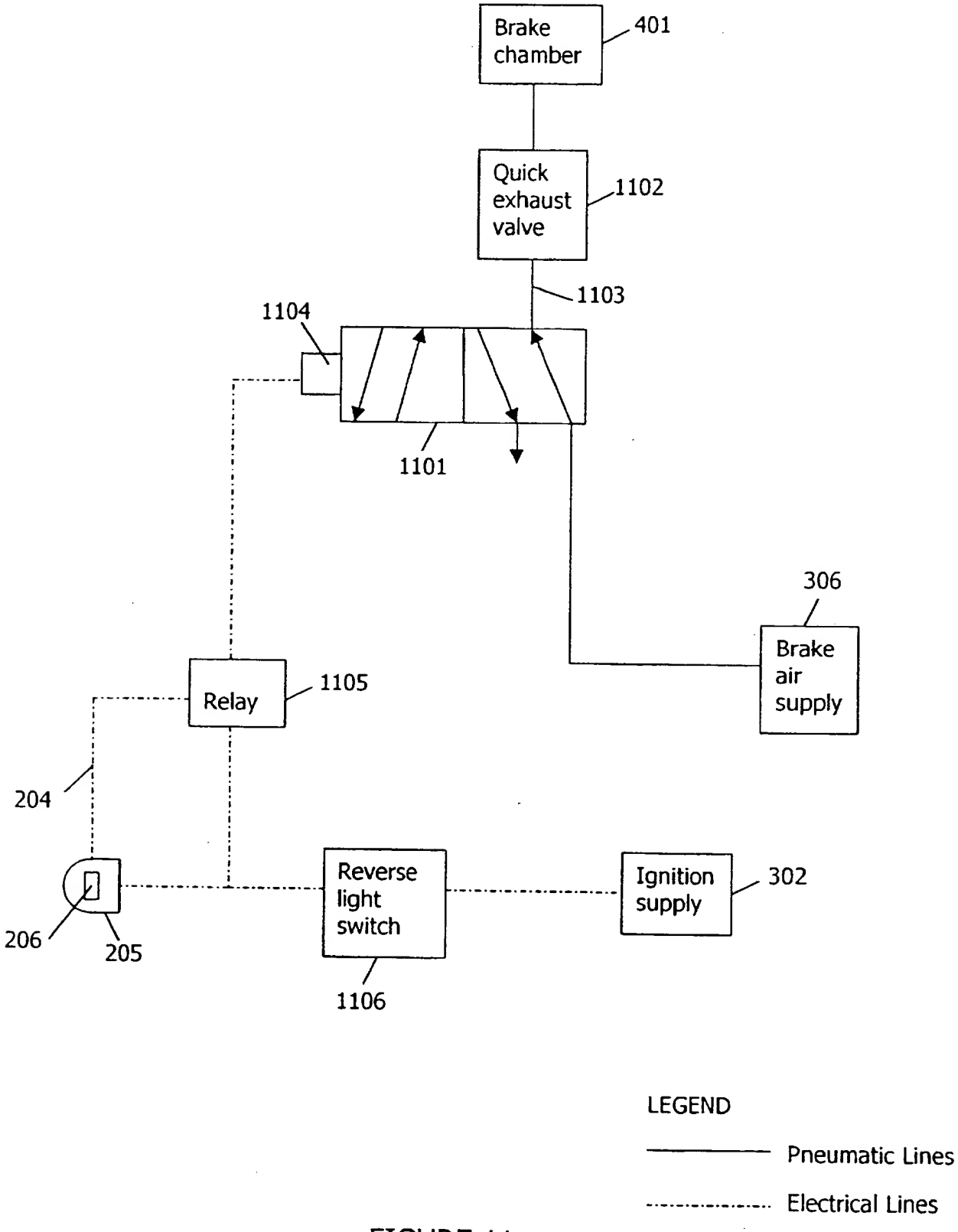
Brake chamber
401
Quick exhaust valve
1102
1103
1104
1101
306
Brake air supply
Relay
1105
204
206
205
Reverse light switch
1106
Ignition supply
302
LEGEND
Pneumatic Lines
Electrical Lines

FIGURE 11

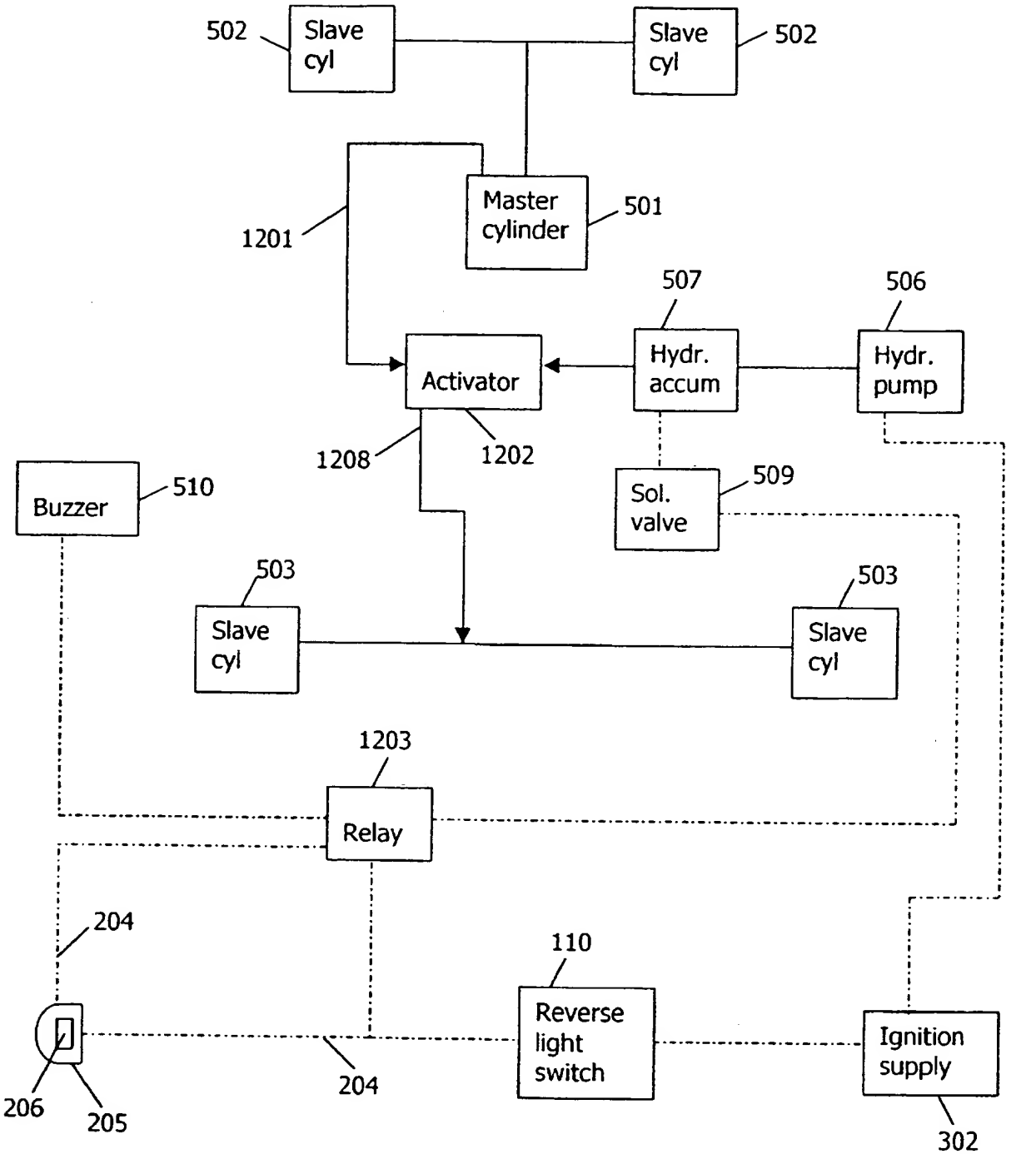
502
Slave cyl
Slave cyl
502
1201
Master cylinder
501
507
506
Activator
Hydr. accum
Hydr. pump
1208
1202
Buzzer
510
Sol. valve
509
503
503
Slave cyl
Slave cyl
1203
Relay
204
110
Reverse light switch
Ignition supply
206
205
204
302
LEGEND
Hydraulic Line
Electrical Line

FIGURE 12

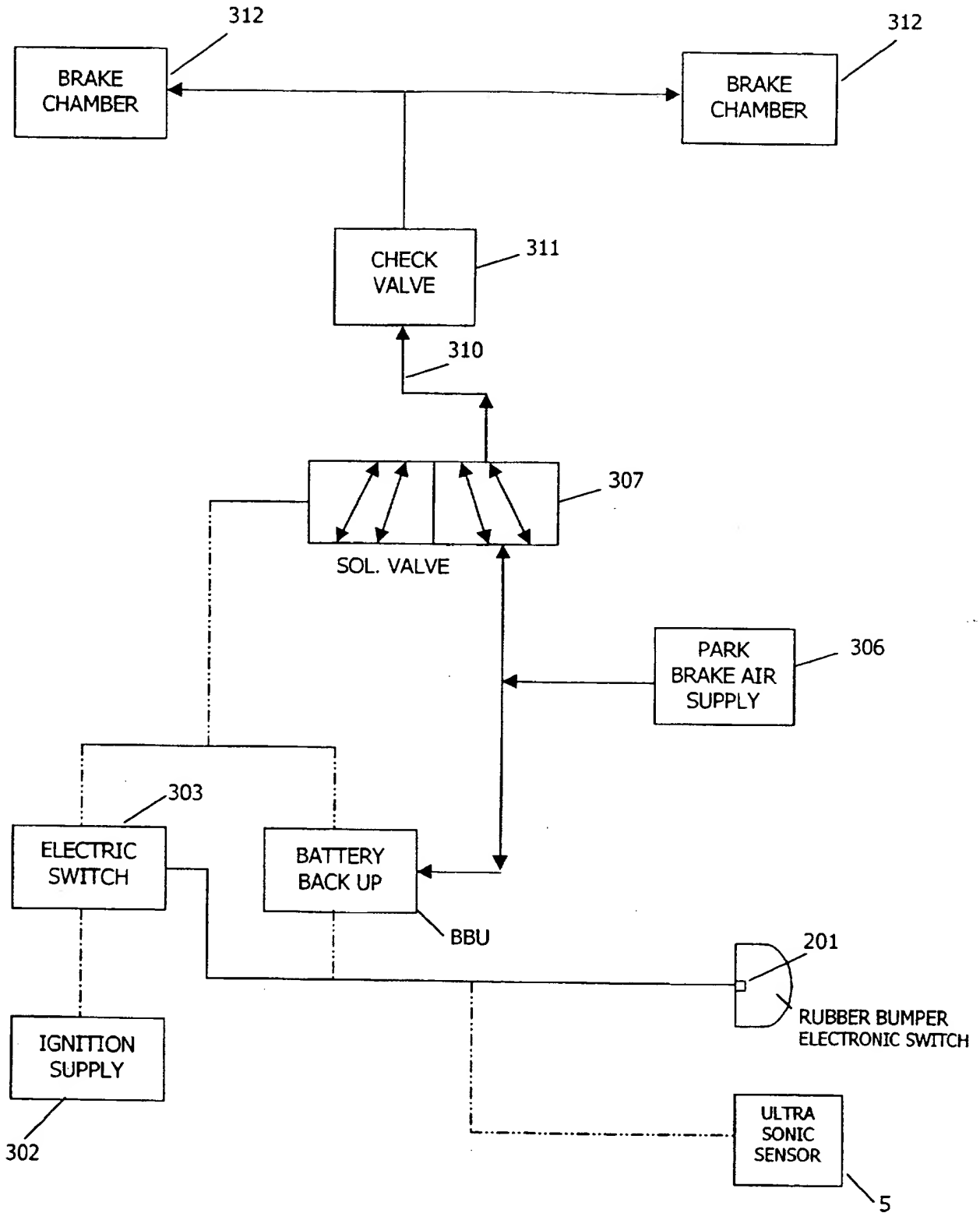
312
BRAKE CHAMBER
312
BRAKE CHAMBER
CHECK VALVE
311
310
307
SOL. VALVE
PARK BRAKE AIR SUPPLY
306
303
ELECTRIC SWITCH
BATTERY BACK UP
BBU
201
RUBBER BUMPER ELECTRONIC SWITCH
IGNITION SUPPLY
302
ULTRA SONIC SENSOR
5

FIGURE 13

The present invention relates to systems for improving safety during low-speed manoeuvring of large vehicles.

In US patent 4,991,681 there is disclosed a system adapted to detect contact between a reversing vehicle and another object and operate the brakes of a vehicle in response thereto.

However the system disclosed in US patent 4,991,681 is intended to be an adjunct to an existing pneumatic braking system of a commercial vehicle, specifically, a tractor-trailer combination. It, therefore, is somewhat limited in its applicability.

It is an object of the present invention to provide a system for improving safety during low-speed manoeuvring of large vehicles which is of wider applicability than that of US patent 4,991,681 and also which is less dependent upon pneumatics for its operation.

According to the present invention there is provided a safety braking system for improving safety during low-speed manoeuvring of large vehicles including means for sensing contact between part of the vehicle to which the apparatus is fitted and another object and generating a contact signal in response thereto, means responsive to the contact signal to apply the brakes of the vehicle and means for rendering the apparatus inoperable when the speed of the vehicle exceeds a predertimined value, wherein the means responsive to the contact signal to apply the brakes of the vehicle comprises a primary switch adapted to respond to the contact signal to energise at least one secondary electromechanical valve adapted when open to admit a brake operating medium to the braking mechanism of the vehicle.

Preferably the primary switch is connected to the electrical power supply of the vehicle via an isolator switch which is adapted to operate when the

speed of the vehicle reaches a predetermined value so preventing operation of the safety braking system above that speed. Also, preferably the connection is made via the ignition switch of the vehicle.

There is included also means for releasing the brakes of the vehicle after operation of the safety braking system and restoring the system to a standby state.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective front view of a motor bus incorporating the invention;

Figure 2A is a cross-section of a pneumatic contact sensor and Figure 2B shows an electrical contact sensor as fitted to the bus shown in Figure 1;

Figure 3 is a schematic diagram of a first safety braking system embodying the invention;

Figure 4 is a schematic diagram of a second safety braking system embodying the invention;

Figure 5 is a schematic diagram of a third safety braking system embodying the invention;

Figure 6 is a schematic diagram of another safety braking system embodying the invention;

Figure 7 is a view of one end of a rear axle of the bus of Figure 1 showing the position of an electromagnetic speed signal generator;

Figure 8 shows in more detail the speed sensor of Figure 7;

Figure 9 is an elevational view of the speed sensor of Figures 7 and 8.

Figure 10 shows a pneumatic sensor installed to prevent a bus such as that of Figure 1 being driven if the passenger door detects an obstruction as it closes.

Figure 11 is a schematic diagram of another safety braking system embodying the invention adapted to operate only when a vehicle to which it is fitted is reversing.

Figure 12 is a schematic diagram of another safety system embodying the invention adapted to operate only when a vehicle to which it is fitted is reversing and for use when the brakes of the vehicle are hydraulically activated.

Figure 13 is a schematic diagram of a modified safety system embodying the invention for use with a tractor-drawn trailer and incorporating a battery back-up valve box which becomes operational to power the system when the electrical connections between the tractor and the trailer are broken.

Referring to Figures 1 and 2 of the drawings, a motor bus 100 includes at least one set of rear wheels 101 mounted upon an axle (not shown in the Figure). In Figure 2A a bumper 102 is mounted across the front of bus 100 and includes a support 103 which carries a pneumatic contact sensor 104 which projects forward of the bumper 102. The pneumatic contact sensor 104 consists of a closed deformable tube 201 which contains air and extends the full width of the body of the bus 100. A pneumatic connection tube 202 projects into the air chamber 203 formed by the closed deformable tube 201. In Figure 2B the integral electrical contact sensor 206 consists of a switch mounted in the rubber bumper sensing tube 205 which extends the full width of the bus 100 and mounted on support 103.

Referring to Figure 3 which is a schematic diagram of a safety braking system embodying the invention, the connection tube 202 connects the contact sensor 104 to a pressure operated primary switch 301, which normally is in a closed state. Electrical power is supplied to primary switch 301 from the ignition switch 302 of the vehicle to which the safety braking system is fitted via solenoid switch 303 which is normally closed,

but is arranged to be opened in response to the vehicle speed signal generated by a sensor 304 described more fully later in the specification thereby rendering the safety braking system inoperative when the vehicle reaches a predetermined velocity. Connected to the primary switch 301 is a solenoid operated secondary valve 305 which normally is closed. When open valve 305 connects a source 306 of pressurised air to one end of shuttle valve 307. A normally closed manually operated valve 308 is arranged, when open, to connect to the source 306 of pressurised air to one end of shuttle valve 307. Also connected to the shuttle valve 307 are a high pressure air feed line 309 and an output air line 310. The output air line 310 from the shuttle valve 307 is connected to check valve 311. The check valve 311 is connected to a normal pneumatic brake operating chamber 312. The main vehicle brake operating system shown diagrammatically as the block designated 313 also is connected to the check valve 312.

The shuttle valve 307 is arranged, in a standby mode, as shown in Figure 3, to close off the air feed line 309 and allow the output air line feed line 310 to vent to atmosphere, so as not to interfere with the operation of the main brake operating system 312 of the vehicle. In an operational mode the shuttle valve 307 is moved to the right in the diagram so as to connect the high pressure air feed line 309 to the air feed line 310 and so operate the brakes of the vehicle to which the system is fitted.

The action of the system is as follows: should the vehicle to which the system is fitted make contact with another vehicle or other object, the tube 201 will deform and produce a pressure pulse in the tube 202. This will cause the primary switch 301 to close. Provided that the ignition switch 302 is turned on and the switch 303 is closed (that is that the speed of the vehicle is below the predetermined value), the valve 305 will be opened, causing the shuttle valve 307 to be moved to its operational position. To reset the system, a driver of the vehicle manually closes the valve 308, causing the shuttle valve 307 to move to its standby position and allow air in the air feed line 310 to vent to atmosphere, so releasing

the brakes of the vehicle. If the electrical sensing bumper 205 is adopted then electrical supply from isolator switch 303 is connected to electrical switch 206 (which may be a simple push-to-close switch) via one of the leads 204 and thence to the solenoid operated secondary valve 305. Should the vehicle make contact with another vehicle, or other object, then switch 206 is energised and sends a signal to solenoid operated secondary valve 305 which causes shuttle valve 307 to be moved to its operational position.

Figure 4 shows a system which is adapted to operate a pneumatically operated parking brake system only on the vehicle. These components which are common to the two systems have the same reference numerals. The effective difference between the two systems is that the air feed line 310 from the shuttle valve 307 is connected directly to the brake operating chamber 401 of the vehicle, allowing the parking brakes of the vehicle to be released.

When the shuttle valve 307 is in its operational position, the pressure in the feed line 310 is vented to atmosphere, so applying the parking brakes of the vehicle.

The action of the system is the same as before.

Figure 5 shows a system for use with a vehicle which has an hydraulically operated braking system. Again, those components which are the same as in the system described with reference to Figure 3, bear the same reference numerals. Referring to Figure 5, a conventional hydraulic braking system master cylinder 501 is connected directly to the front wheel slave cylinders 502 of the vehicle braking system, in the usual way, and to the rear wheel slave cylinders 503 via a normally open solenoid operated valve 504. Also connected across the valve 504, and forming an hydraulic loop 505 are an auxiliary hydraulic pump 506, a one-way valve 507, and hydraulic accumulator 508 and another, normally closed,

solenoid valve operated valve 509. A buzzer 510 and a warning light 511 and a reset button also are connected to the switch 301.

The speed sensitive part of the system operates as before. The operation of the remainder of the system is as follows: when the foot brake pedal (not shown) is depressed, brake fluid flows from the master cylinder 501 to the front wheel slave cylinders 502 and to the rear wheel slave cylinders 503 via the normally open solenoid valve 504. Hydraulic fluid also is supplied to the auxiliary hydraulic pump 506 and via the shuttle valve 507 to the hydraulic pressure accumulator 508. Further flow in the hydraulic loop 505 is prevented by the normally closed solenoid valve 509.

Should the vehicle make contact with another vehicle or other object, then as before, providing the speed of the vehicle is below the predetermined value, the primary switch 301 is closed and in this case energises the two secondary electromechanical valves 504 and 509, closing the valve 504 and opening valve 509 so allowing hydraulic fluid to flow from the accumulator 508 to the rear wheel slave cylinders 503. The buzzer 510 and warning light 511 are also activated. The closure of valves 504 and 509 are de-energised and the hydraulic pump 506 is operated to re-pressurise the hydraulic accumulator 509.

Figure 6 shows another system adapted to operate only when a vehicle to which it is fitted is reversing. Again, those components which are common to this system and that described with reference to Figure 1 have the same reference numbers. A major difference is that the speed override control system is omitted.

Referring to Figure 6, the shuttle valve 307 of the embodiments is replaced by a solenoid operated shuttle valve 601. Connected to the shuttle valve 601 is a relay 602, which is adapted to connect the pressure operated primary switch 301 to one or other of the operating solenoids 603, 604 of the shuttle valve 601. Power is supplied to the relay 602 via the vehicle reversing light power supply 605 and the primary switch 301.

Also connected to the relay 602 is the vehicle stop light switch 606. A warning buzzer 608 is arranged to be activated when the shuttle valve 601 is in its operating state. A warning light 609 is also energised, as before. In a normal vehicle operating condition, the shuttle valve 601 is arranged (as shown) to connect the source 306 of pressurised air to brake operating chambers 607 which causes the parking brakes of the vehicle to be released. No power is applied to the primary switch 301 and the relay 603 and solenoids 603 and 604 ate in a quiescent state. When reverse gear is selected however, then power is supplied to the primary switch 301 so putting the system in a standby state.

The operation of the system is as follows: as before, should the vehicle to which the system is fitted come into contact with another vehicle, or other object, then a pressure pulse is generated, which causes the primary switch to close. This causes the relay 602 to energise the shuttle valve 601 operating solenoid 604, causing the shuttle valve 601 to move to a position where brake chambers 607 are vented to atmosphere, so applying the spring-loaded parking brakes of the vehicle. At the same time the warning buzzer 608 is sounded. To release the brakes the vehicle operator takes the vehicle out of reverse gear, which allows the relay 602 to change position. The operator then presses the footbrake pedal, causing the stop lights to be energised. This applies a pulse of power to the relay 602 contacts and thence to the solenoid 603 of the shuttle valve 601 causing it to revert to its original position at which the air supply 306 is connected to the parking brake operating chambers, sop causing the parking brakes to be released.

Referring to Figures 7, 8 and 9, which illustrate the action of the speed sensor 304, a plurality of magnets 71 are mounted in the inner edge 72 of a rear brake drum 73 of the vehicle to which the safety braking system is fitted. Positioned in the corresponding brake back plate 74 is a sensor 75 which generates an electrical pulse each time a magnet 71 passes it. The pulses are used to provide the speed signal which is applied to the switch

303 and which causes it to isolate the primary switch 301 when the speed of the vehicle exceeds the predetermined value, so disarming the safety braking system. Speed signal also can be derived from rotating members such as alternators, magnetic sensors in the transmission housing, electronic transmission speedometer cables, transmission transducers and from computerised engine ignition systems among others.

Figure 10 illustrates a system in which the contact sensors 201 or 206 are mounted in the doorway 1001 of a vehicle such as the bus in Figure 1, so that should the door 1000 of the bus detect an obstruction, such as a person in the doorway 1001 of the bus, as it closes, then the brakes are applied and the bus cannot move until the obstruction has been cleared. The contact sensor can be made to operate in the opposite sense. That is to say, it can be made to detect when contact between the door 1000 and the doorway 1001 of the bus ceases and cause the brakes to be applied whenever the door is open or fails to close properly. As before, a buzzer and warning light (not shown) are included.

Figure 11 shows another safety system using the electrical contact sensing strip of Figure 2B, in which the shuttle valve 307 of the embodiment of the invention described previously is replaced by a solenoid / spring shuttle valve 1101. The shuttle valve 1101 is connected to the brake air pressure supply system 306 and to the quick release exhaust valve 1102 via a line 1103. Also connected to the exhaust valve 1102 are the brake chambers 401. The solenoid valve 1104 of the shuttle valve 1101 is connected via a relay 1105 to the electrical contact sensor 206. The electrical contact sensor 206 and the relay 1105 are both supplied with electrical power via the reversing light switch 1106.

The operation of the system is as follows: during forward motion of the vehicle air is allowed by the shuttle valve 1101 to pass from the brake air supply 306 into the exhaust valve 1102 and thence into the brake actuating chambers 401 so releasing the parking brakes of the vehicle.

Should reverse gear be selected, then the system is armed by electrical power being supplied to the electrical contact sensor 206 and the relay 1105. Should the vehicle then come into contact with another vehicle or other object so as to close the contact sensor 206 then the relay 1105 is caused to operate the solenoid of shuttle valve 1101 which then moves to a position where the brake air supply is held at shuttle valve 323 and air in line 1103 is exhausted to atmosphere so venting the brake chambers 401 through quick exhaust valve 1102, so applying the spring loaded brakes of the vehicle. To release the brakes the vehicle operator takes the vehicle out of reverse gear., so de-energising the relay 1105 and the solenoid 1104 of the shuttle valve 1101. The spring return of the shuttle valve 1101 returns it to its original position.

Figure 12 shows a further reverse safety braking system which is for use with vehicles with hydraulically operated braking system and which utilises the electrical contact sensor of Figure 2B. These components which are common to this embodiment and that of Figure 5 bear the same reference numerals.

Referring to Figure 12, a conventional hydraulic braking system master cylinder 501 is connected directly to the front wheel slave cylinders 502 of the vehicle braking system, in the usual way and to the rear wheel slave cylinders 503 via an hydraulic line 1201, an actuator 1202 and hydraulic line 1208. In its normal setting the actuator 1202 allows the rear wheel brake application in the normal way. As in the previously described embodiment, an electrical contact sensor 206 and relay 1203 are energised via the reverse light switch 1204 of the vehicle. The relay 1203 is connected to a warning buzzer 510 and to solenoid valve 509 which operates to connect an hydraulic accumulator 507 to the actuator 1202.

The system works as follows: When the ignition (or glow plug in the case of a diesel engine) switch 302 is turned on, an electrically operated hydraulic pump 506 generates hydraulic pressure in accumulator 507, in

the usual way. On selection of reverse gear the contact sensor 206 and relay 1203 are energised as for the previous embodiment of the invention. Should the vehicle make contact with another vehicle, or other object with impact sufficient to actuate the contact sensor switch 206, the relay 1203 is closed and power is supplied to solenoid valve 509 which connects the hydraulic accumulator 507 to the actuator valve 1202. This causes a piston to move in the actuator valve 1202 to close off the hydraulic line 1201 and allow fluid pressure from the hydraulic accumulator to operate the rear wheel brakes of the vehicle. To reset the system the operator takes the vehicle out of reverse gear which de-energises relay 1203, the contact sensor 206, warning buzzer 510 and solenoid valve 509. The actuator opens the connection between the slave cylinders 503 and the master cylinder 501, so releasing the rear wheel brakes of the vehicle. Simultaneously the hydraulic pump 506 re-pressurises the hydraulic accumulator 507.

The modified safety braking system shown in Figure 13 is for use with a tractor-drawn trailer.

To this end the system is provided with a battery back-up valve box BBU which comes into play when the emergency / park brake light is connected to the trailer and the electrical connections are broken. Without the battery back-up valve box BBU in a situation like this there would be no power from the tractor battery to drive the system as with the previous embodiments.

In Figure 13 the battery back-up valve box BBU is connected between the bumper 201 and the solenoid valve 307 and is activated by the foot brake air supply 306 to operate the solenoid valve 307.

With the electrical connection between the tractor and trailer broken, then the ignition supply 302 and electrical switch 303 components take no part in the safety braking system.

When the trailer is shunted into a target area ultrasonic sensors S, or the electrical switch within the rubber bumper 201 which provides a signal to the battery back-up valve box BBU to actuate the solenoid valve 307 causing it to change position and apply the brakes. By electronic means provided in the

battery back-up valve box BBU brakes of the trailer are applied for 5 seconds and then released.

When the park brake air supply 306 is disconnected by an operative the system is closed down.

When the tractor couples to the trailer and all air and electrical connections are made then electrical means provided in the battery back-up valve box BBU actuate whereby power from the tractor is used to recharge the battery of the valve box BBU.

The ultrasonic sensors S for sensing movement of the trailer, provide a signal to the valve box BBU when the trailer is at a pre-determined distance from a target object. Before the ultrasonic sensors S provide a signal to the valve box BBU to activate the brakes of the trailer, the trailer is allowed to move backwards within a pre-determined distance. The ultrasonic sensors S reset after movement of more than 300 mm away from the target object.

Claims

1. A safety braking system for improving safety during low speed manoeuvring of large vehicles including means for sensing contact between a part of a vehicle to which the apparatus is fitted and another object and generating a contact signal in response thereto, means responsive to the contact signal to apply the brakes of the vehicle and means for rendering the apparatus inoperative when the speed of the vehicle exceeds the predetermined value, wherein the means responsive for the contact signal to apply the brakes of the vehicle comprises a primary switch adapted to respond to the contact signal to energise at least one secondary electromechanical valve adapted when open to admit a brake operating medium to the brake operating mechanism of the vehicle.

2. A safety braking system according to Claim 1 wherein there is included a means for releasing the brakes of the vehicle after operation of the safety braking system and restoring the safety braking system to a standby condition.

3. A safety braking system according to Claim 1 or Claim 2 wherein the primary switch is connected to the electrical power supply of the vehicle via an isolator switch which is adapted to operate when the speed of the vehicle exceeds the predetermined value.

4. A safety braking system according to Claim 3 wherein there is included means for generating an electrical signal related to the speed of the vehicle and the isolator switch is adapted to operate when the said signal exceeds a value corresponding to the said predetermined value of the speed of the vehicle.

5. A safety braking system according to any previous claim wherein the braking operating medium is pressurised air and there is included a shuttle valve which is in response to the operation of the secondary electro-mechanical valve is moved to a first position to admit pressurised air to the braking system of the vehicle and in response to the means of releasing the brakes of the vehicle after operation of the safety braking system is moved to a second position to release the pressure in the brake mechanism of the vehicle.

6. A safety braking system according to Claim 5 wherein the means for releasing the brakes of the vehicle after operation of the safety braking system comprises a spring-loaded valve which when operated by the driver of the vehicle admits pressurised air to the shuttle valve to cause it to move to the said second position.

7. A safety braking system according to any previous claim where the means of arming the system to a standby mode is by an electrical signal generated from the reversing light switch, whereby the system is adapted to respond to a contact signal and cause the brakes of the vehicle to be applied by a spring-loaded shuttle valve. The means of releasing the brakes and dis-arming the system is by the driver taking the vehicle out of reverse gear.

8. A safety braking system according to Claims 1 to 4 wherein the braking system of the vehicle is hydraulically operated and the secondary electro-mechanical valve is adapted when operated to admit hydraulic braking fluid at least the rear wheel cylinders of the vehicle

9. A safety braking system according to Claim 7 wherein the means of releasing the brakes of the vehicle after operation of the safety braking system comprises a normally closed solenoid operated valve which is energised to permit hydraulic fluid to return to an hydraulic accumulator.

10. A safety braking system according to any preceding claim wherein the means for generating the contact signal is mounted in a bumper of the vehicle.

11. A safety braking system according to any preceding claim wherein the means of generating the contact signal is so positioned in relation to a door of the vehicle that contact is made with an object as the door of the vehicle is being closed, the brakes of the vehicle are applied thereby to prevent movement of the vehicle whilst the door is open, and means of generating a warning device.

12. A safety braking system according to any preceding claim wherein the means of generating a signal in relation to the door of the vehicle being open, the brakes of the vehicle to be applied thereby preventing movement of the vehicle while the door is open, and means of generating a warning device.

13. A safety braking system according to Claim 10 wherein the vehicle is a public service vehicle.

14. A safety braking system according to any preceding claim wherein the means for generating a contact signal comprising a fluid filled deformable chamber and the primary switch is adapted to respond to a pressure pulse generated within the deformable chamber by contact between the vehicle and the said other object.

15. A safety braking system according to any preceding claim wherein the means of generating a contact signal comprises an integral electrical switch mounted in a deformable rubber bumper so adapted as to respond to pressure on the rubber bumper and generate a signal.

16. A safety braking system according to any preceding claim wherein the means responsive to the contact signal is adapted to operate a warning device.

17. A safety braking system substantially as hereinbefore described and with reference to the accompanying drawings.

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Claims searched: **Date of search:** 16 December 1999

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F2F FC B7H HXGREM HXJ

Int Cl (Ed.6): B60T 7/12, 22 B60K 28/10, 12, 14 41/26

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2118753 A	(Ogden) see e.g. page 2 lines 24-62	
X	EP 0298714 A2	(SBR) = US 4991681, see e.g.col.5 line 19 to col.6 line 12	
X	WO 90/12711 A1	(Backstop) see e.g.description relating to Figs.4-6 on pages 5-9	
X	US 5714928	(Sudo et al) see e.g.col.5 lines 4-43	
X	US 5653568	(Josephs) see whole document	
X	US 4838617	(Deitchman et al) see e.g. col.3 lines 24-64 and col.7 lines 32-35	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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